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SYNOPSIS

The fossil mammalian fauna from Bethlehem contains characteristically Villafranchian forms such as *Archidiskodon* cf. *planifrons* and *Leptobos*. It further comprises at least five species known from Villafranchian sites in Eurasia. As at Villarroya (Spain) and at Tatrot (India), which are likewise Villafranchian assemblages, there is *Hipparion* but no *Equus*. However, the Bethlehem fauna differs from those of the Eurasian Villafranchian in the presence of *Giraffa* cf. *camelopardalis* and in the absence of Cervidae; this puts an African " stamp " upon the Bethlehem fauna, as may have been expected *a priori* from its geographical position.

THE fossil mammalian remains described in the present paper were found at the highest point of Bethlehem, Israel, 790 m. above sea-level. The first bones were accidentally found by the owner of a garden digging for water; in 1934 Miss D. M. A. Bate drew attention to this discovery (Bate, 1934). In 1935 and 1936 under the auspices of the Department of Antiquities, Palestine, the Wellcome Archaeological Research Expedition to the Near East, with Miss Bate as palaeontologist and Miss E. W. Gardner as geologist, undertook the excavation of the bone-bearing beds of Bethlehem. Work was continued in 1937 through the support of the trustees of Sir Henry Wellcome and Sir Robert Mond. Finally, in 1940 the excavation was completed by Dr. M. Stekelis of the Hebrew University, Jerusalem. The geology and archaeology of the site was described by Miss Gardner, and Miss Bate contributed a discussion of the fossil vertebrate fauna (Gardner & Bate, 1937). In this paper Miss Bate, after a preliminary examination of the fossils, concluded that the Bethlehem fauna " is not later than Early Pleistocene, using this term palaeontologically as indicating the time of arrival of true *Bos*, *Elephas*, and *Equus* . . . Further, it is claimed for this fauna that it will provide a faunistic link for this period between Asia and East Africa . . . ". The following mammals were listed:

Felis sp. (size of *Panthera leo*)
Hippopotamus sp.
Bos sp.
Antelope.
Giraffoid.
Hipparion sp.
Rhinoceros cf. *etruscus*
Stegodon sp.
Elephas sp.
Small carnivore.

In a subsequent note, dealing with the results of the 1940 excavation reported upon by Dr. Stekelis, Miss Bate added " *Equus* sp. (? *Hipparion*) " (Bate, 1941).

The fossil collections obtained at Bethlehem were sent to the British Museum (Natural History) for study and description by Miss Bate, whose death in 1951 prevented completion of this phase of her Palestinian work, to which she had devoted so much of her time and energy.

In the summer of 1956 I had the opportunity of examining the Bethlehem collection at the British Museum (Natural History), and Dr. E. I. White, Keeper of the Department of Palaeontology, most kindly consented to send the material selected for further examination on loan to me in Leiden. I am much indebted to Dr. White for facilitating my study of this interesting fauna. To Dr. A. T. Hopwood I owe valuable information and kind advice. Mr. A. J. Sutcliffe was very helpful in arranging the shipment of the collection. The photographs were taken by Mr. H. F. Roman of the Rijksmuseum van Natuurlijke Historie at Leiden, with the exception of those of Pl. 32, which were made at the British Museum (Natural History). All this is here gratefully acknowledged.

The results of my study are given in the present paper. The material is preserved in the Department of Palaeontology of the British Museum (Natural History); registration numbers are given in each case. Unless otherwise stated, the measurements recorded in the present work are in mm.

CARNIVORA

Canidae

Nyctereutes megamastoides (Pomel)

(Pl. 34, fig. 7)

In her second note on the Bethlehem fossils Miss Bate (Gardner & Bate, 1937) mentioned a small carnivore, " but its remains are extremely fragile and have not yet been extracted from the matrix ". When I received the collection the small carnivore remains had been treated with preservative, and removed from the matrix. It is evident that both the teeth and the bones were broken before removal from the deposit; a number of teeth and some vertebrae are partially embedded in plaster, apparently because otherwise they could not be preserved.

Although the carnivore remains are in a bad state of preservation their specific identity is certain: they belong to *Nyctereutes megamastoides* (Pomel), a species characterized by its small teeth; the large size of M^1 relative to P^4; the slightly reduced M^2; the high and laterally compressed lower premolars with a concave posterior slope of the protoconid which bears an accessory cusp only in P_4; the elongated M_2; and the oval-shaped M_3. The mandibular ramus is quite slender, and, above all, characterized by the peculiar development of the subangular process or lobe; this character cannot be observed in the Bethlehem material. There are two portions of the left mandibular ramus (M 18521), one with P_{3-4}, and the other with M_{2-3}, and also parts of the coronoid and the condyloid processes, apparently of the same individual. The upper dentition is represented by a left canine (M 18516), P^{3-4} sin. and M^{1-2} sin. (much worn down) (M 18512), and a P^4 dext. (M 18521). Post-cranial remains (M 18521) comprise several cervical vertebrae including a

partial epistropheus, proximal and distal portions of a right humerus, the proximal ends of a left radius and ulna, the head of a right femur, a left astragalus and calcaneum, and a great many fragments of the shafts of the long bones, of metapodials, foot bones, and phalanges. In Table I the measurements of the Bethlehem teeth are compared with those of *Nyctereutes megamastoides* from Perrier (Boule, 1889) and from Villarroya (Villalta, 1952 : 42). There is no significant difference between the Bethlehem teeth and those of the Villafranchian of Europe.

TABLE I.—*Measurements of* Nyctereutes megamastoides

	Bethlehem	Perrier	Villarroya
P^3, length	8·5	8	—
width	3·1	3	—
P^4, length	12·7	13	—
width	5·6	6	—
M^1, length	10·2	10·5	—
width	*c.* 12	11·5	—
M^2, length	7·1	7	—
width	—	9	—
P_3, length	7·8	7·3	7–8
width	3·0	2·5	2–3
P_4, length	9·6	9	7–9·5
width	4·0	3	3–3·5
M_2, length	8·2	8·5	7–9·5
width	5·6	5	5–6
M_3, length	4·4	4·5	—
width	3·8	3·5	—
Height of ramus between P_2 and P_4	12·5	13	—
Maximum width	6·5	6	—

Besides Perrier (Les Etouaires and Roccaneyra : Bout & Azzaroli, 1952) and Villarroya, other Villafranchian localities that yield *Nyctereutes megamastoides* are the Val d'Arno, Sénèze, and Saint Vallier (Viret, 1954). The remains described as *Canis* (*Nyctereutes*) *sinensis* Schlosser from the Villafranchian of Nihowan, China (Teilhard de Chardin & Piveteau, 1930 : 88, pl. 17, figs. 1–3, pl. 18, figs. 2–3), and from the Middle Pleistocene of Choukoutien (Pei, 1934 : 23, pl. 3, figs. 1, 2, 4–6, 8, 10 ; pl. 4, figs. 1–3) appear to be at most subspecifically distinct from *Nyctereutes megamastoides*. As related by Pei (1934 : 31), the Chinese *Nyctereutes* has been traced back to the Middle Pliocene ; the Villafranchian remains are, on the average, a little larger than those from the Middle Pleistocene, and the Upper Pleistocene remains (Pei, 1940 : 15) as well as the protohistoric remains of Anyang (Teilhard de Chardin & Young, 1936 : 7) are as small as, and have been referred to the Recent *Nyctereutes procyonoides* (Gray), the " raccoon-dog " of Eastern Siberia, Japan, China, and Northern Indo-China. In view of this fossil record it is probable that *Nyctereutes megamastoides* arose in China, and should be considered a Villafranchian immigrant to Europe. The remains in the Bethlehem collection indicate that *Nyctereutes megamastoides*, in its east-west migration at the beginning of the Pleistocene, spread also to the Eastern Mediterranean region. There are no records of the species from Africa.

Felidae

Homotherium (?) sp.

(Pl. 34, figs. 1, 2)

A large machairodontine is represented in the Bethlehem collection by a left M_1 (M 18511), incomplete in front as well as behind. The top of the paraconid is missing. The powerful anterior root (below the paraconid) is for the most part preserved; the posterior root is broken off. Although the development of the metaconid and of the talonid cannot be studied in the present incomplete specimen, the wide concave area between the paraconid and the protoconid blades internally, and the mode of wear of the crown are machairodontine. The greatest length of the crown must have been over 30 mm.; the greatest width is 14·1 mm. These figures suggest a form similar in size to *Homotherium crenatidens* Fabrini from Perrier (length of M_1, 32 mm.: Teilhard de Chardin & Piveteau, 1930 : 116, footnote), a Villafranchian species also known from Sénèze, the Val d'Arno, Chagny, Villarroya, and Saint Vallier (Schaub, 1944; Viret, 1954, table opposite p. 184). Kretzoi (1954 : 250), whose *Epimachairodus* is a synonym of *Homotherium* Fabrini (Simpson, 1945 : 121; Arambourg, 1947 : 438; Viret, 1954 : 78), records remains probably referable to *H. crenatidens* from the Villafranchian site of Kisláng in Hungary.

According to Schaub (1934), part of the material described as *Machairodus nihowanensis* by Teilhard de Chardin & Piveteau (1930, pl. 22, fig. 2) does not seem to be specifically distinct from *H. crenatidens* from the Villafranchian of Europe. This Early Pleistocene form from Nihowan is succeeded in the Middle Pleistocene by *Homotherium ultimum* (Teilhard de Chardin) from Choukoutien, the lower carnassial of which measures 32 by 12 mm. (Teilhard de Chardin & Pei, 1941 : 40).

Homotherium (?) sp. from Bethlehem is too incompletely known to allow of a definite identification. Similar large machairodontines are recorded from the Villafranchian of East and South Africa (Arambourg, 1947 : 438; Ewer, 1955 : 612). Whether the affinities of the Bethlehem form lie with the Eurasian or with the African species cannot be decided until better specimens are available.

PROBOSCIDEA

Elephantidae

Archidiskodon cf. *planifrons* (Falconer & Cautley)

(Pl. 32; Pl. 34; figs. 3, 4; Pl. 35, figs. 1, 2)

A mandible without the ascending rami, collected by Dr. M. Stekelis in 1940 (M 18582, Pl. 32, figs. 1, 2), is one of the most diagnostic specimens found. Like several of the others, this specimen is crushed, indicating the pressure to which the bone-bearing beds were formerly subjected. The right horizontal ramus has been pressed on from above and laterally, but the left ramus is only slightly distorted. The last molars are *in situ* on both sides; the M_3 dext. is fractured between the 4th

and 5th plates from the front, and the two portions are displaced along the fracture, but M_3 sin. is undamaged. What remains of the ascending rami shows that their anterior borders are on a level with the 6th plates of M_3.

The symphysis is obliquely prolonged downward, forming a projection or " beak " just as in the mandible of *Archidiskodon planifrons* from the Siwalik Hills figured by Falconer & Cautley (1845, pl. 8, fig. 2*a*). This is a very characteristic feature of the species in question ; it is also present in the mandibles from Sénèze and from Chagny (Mayet & Roman, 1923 : 81, fig. 13). In the Bethlehem mandible as well as in the Siwalik specimen, which I have studied in the British Museum (Natural History) (regd. 36736), the beak is not complete ; in the French specimens the length of the beak is about equal to the height of the ramus below M_3. The portion preserved in the Bethlehem mandible is about 7 cm. long ; it has a height of 7–8 cm., and is about 4 cm. wide, just as in the Siwalik specimen referred to above. Because of the presence of this anterior downward projection of the symphysis the lower border of the ramus is concavo-convex from before backward, the convexity beginning approximately at the level of the anterior border of M_3. Presumably part of the M_2 was still in place at the time of the animal's death, but is now lost. The height of the ramus below the middle of M_3 is 15 cm., equal to the greatest width, measurements that correspond well with those of the mandible of *A. planifrons* figured by Falconer & Cautley (1845, pl. 8, fig. 2) as well as with those of an unfigured mandible of the same species in the British Museum (M 3090). There are two mental foramina on each side, a large one at the middle of the height of the outer surface of the ramus, on a level with the posterior border of the symphysis, and a smaller one about 5 cm. below and anterior to the former. In the unfigured mandible of *A. planifrons* from the Siwaliks the number and position of the foramina is the same ; in the figured mandible the larger of the mental foramina is duplicated on the right side but single on the left, and the distance between this and the smaller foramen is 6·5 cm. On either side of the depressed anterior surface of the beak a ridge runs upward to the alveolar edge ; the upper portion of this ridge is badly damaged in the Bethlehem mandible, but its lower part forms an angle of about 120° with the occlusal surface of the molar as in the two Siwalik specimens.

So far as the state of preservation of the Bethlehem mandible permits one to form an opinion, there is nothing to distinguish it from the mandible of *Archidiskodon planifrons* from the Upper Siwaliks.

The same is true of the molar, M_3. In the Bethlehem mandible M_3 is worn to and including the 6th plate from the front, and there are ten plates in all, besides the talonids. The greatest length of the crown, in a straight line from the middle of the anterior border to the heel, is 290 mm.; the greatest width, at the 2nd plate from the front, is 93 mm., cement included, and 84 mm. exclusive of cement. The height of the foremost unworn plate, plate 7, is 94 mm.; the slightly worn 6th plate has the same height and, therefore, must have been somewhat higher when unworn. In height it cannot have exceeded 100 mm., however, for the dentine cores of the conelets do not show yet, and the enamel thickness of the plates is about 6 mm. The cement coat is heavy ; even the sides of the plates are completely covered.

The enamel figure of the anterior talonid is confluent with that of the first plate ; only a labial enamel fold remains to indicate the boundary between the two. Plate 1

has a postero-median enamel projection that makes contact with a similar projection on the anterior surface of plate 2. Plates 2 and 3 are worn to single enamel figures, with median anterior and posterior expansions blocking up the valleys in between, which are open on either side, the antero-posterior width of the valleys being equal to that of the plates. The enamel is 6 mm. thick, and is slightly crimped.

Passing backward along the crown, the enamel expansions of the plate figures become less marked. In plate 3 the enamel border forms an almost entire loop, just to the labial side of the median line of the crown, with a diameter of 13 mm. and projecting 8 mm. posteriorly. The posterior expansion of plate 4 projects only 5 mm. beyond the surface. The width of the enamel figure of plate 4 is only 70 mm., whereas the greatest width of the same plate, including cement, is the same as that of plate 2, 93 mm. The enamel figure of plate 4 is constricted on either side of the median expansion, forming a transversely elongated enamel figure on either side of the central, antero-posteriorly extended figure. Of the lateral figures that on the lingual side is longer. In the right M_3 plate 4 is slightly less worn than that in the left, and the three enamel figures are distinctly separate.

In plate 5 the grooves between the conelets are still visible. There appear to be four conelets, the second from the labial side being more extended antero-posteriorly than either of the others. It is this conelet that forms the central expansion of the more worn plates in front. In plate 5 the two central conelets together measure 26 mm. transversely, the total width of the four enamel conelets being 63 mm. The greatest (basal) width of this plate, cement included, is again 93 mm. Plate 6 has the four conelets just touched by wear, the two in the centre occupying a width of 26 mm., as in plate 5. In plate 7 the conelets are still covered up with cement; evidently this plate had not erupted at the time of death.

From plate 7 backward the plates begin to diminish in width as well as in height; the basal widths cannot be measured as the base of the crown is not fully exposed, but the heights decrease from 88 mm. in plate 8 to 80 mm. in plate 9, then to 70 mm. in plate 10, the terminal full plate. The talonid is barely 50 mm. high with a width of about 35 mm., and is completely covered with cement. Because of the outward curvature of the hinder end of the molar the talonid is rather obliquely placed: it is in the same antero-posterior line as the labial ends of the foremost plate-figures.

The laminar frequency of the molar, that is, the number of plates per 10 cm. of antero-posterior length, varies somewhat with the place in which it is taken. The laminar frequency is just under 4 in the middle of the occlusal surface, the distance from the middle of the valley between plates 1 and 2 to the middle of the valley between plates 5 and 6 (covering four plates and four cement intervals) being 106 mm. When taken at the base lingually, which is exposed from the 4th plate backward in the left M_3, the laminar frequency is distinctly lower, not only because of the curvature of the long axis of the crown with the convexity inward, but also because of the rootward divergence of the plates, characteristic of lower molars. The laminar frequency is only 3 at the base lingually; at the labial alveolar margin it is 4.

The low plate formula ($\times$ 10 $\times$), the low laminar frequency (3–4), the height of the crown that hardly exceeds the greatest width (height-width index (plate height-width indices cannot be given) just over 100) the presence of median looped expan-

sions of the enamel figures of the moderately worn plates, the great thickness of the enamel (6 mm.), and the abundance of cement, are characters that leave no doubt as to the specific identity of the Bethlehem elephant : it belongs to the most primitive archidiskodont stage exemplified by *Archidiskodon planifrons* of the Upper Siwaliks of India. In the characters of the mandible, notably in the downturned anterior end of the symphysis, the present Bethlehem specimen agrees perfectly with those from the Siwaliks and from certain Villafranchian sites in Europe.

A number of isolated molars and molar fragments in the Bethlehem collection are described below.

A right upper second molar collected in 1940 (M 18523, Pl. 34, figs. 3, 4) is only slightly damaged. The molar carries nine plates, five of which are worn, as well as the damaged anterior and posterior talons. The roots are preserved for the most part. The crown as a whole is slightly curved : the lingual surface is concave from before backward, and the labial surface is convex antero-posteriorly. The base of the crown is concave antero-posteriorly towards the roots. The total length of the crown is 262 mm.

The enamel figures of the anterior worn plates show the characteristic median expansions (just to the lingual side of the median line), the posterior loop of the 2nd and the anterior loop of the 3rd plates almost make a contact across the valley, which is filled with cement. The enamel thickness is 5–6 mm. Plate 5 has four conelets, the second from the lingual side being the largest. The remaining plates are fully embedded in cement, as well as the incomplete and very small terminal plate, the talon. Measurements are given in Table II.

TABLE II.—*Measurements of M² dext. of* A. *cf.* planifrons (*M* 18523)

	No. of plate									
	1	2	3	4	5	6	7	8	9	Talon
Width . . .	—	102	103	100	100	100	97	83	55	. *c.* 30
Height . . .	—	—	—	—	—	84	81	74	*c.* 58	. —
Height-width index .	—	—	—	—	—	84	84	89	*c.* 105	. —

As shown by the height-width indices of the unworn plates, the plates are either lower or slightly higher than wide. The laminar frequency of the present specimen varies from 3 (in the middle of the worn surface) to $3\frac{1}{2}$ (at the base lingually). There is one powerful anterior root supporting the first two plates, a very large single root supporting the posterior five plates, and three intermediate roots, two labial and one lingual. The apical portions of these roots are broken off ; the portions preserved are as long as the height of the (unworn) crown.

In the Upper Siwalik *A. planifrons* the number of plates in M^2 varies from eight to nine. The length of the crown of the Bethlehem M^2 (262 mm.) is greater than that of any M^2 of *A. planifrons* from the Siwalik Hills as recorded by Falconer and by Osborn (see Osborn, 1942 : 949, 954 : 191–221 mm.), but this is not a matter of great moment, for an unquestionable M_2 of *A. planifrons* from the Punjab (Hooijer, 1955 : 99–101) is 261 mm. long against 178–204 mm. in Falconer's and Osborn's series of

Siwalik M_2, which tends to show that upper second molars of the size of the Bethlehem specimen occur in the Upper Siwalik *A. planifrons* also.

A left upper second molar (M 18524) is unworn (Pl. 35, figs. 1, 2). There are eight plates, plus the talons. Much of the enamel along the base of the crown is gone: the lingual edges of plates 1, 2, 7, and 8, and the external conelets and edges of plates 3 to 7, inclusive, are missing. However, it is mostly only the enamel coat that is lost, and the enamel thickness, wherever exposed in the present specimen, is 6 mm. Therefore, it is possible to give the basal widths of most of the plates by taking the actual width, and adding to it 6 mm. for the missing enamel layer. Cement is heavily developed; it covers up the conelets and the edges of all but the hindmost three plates. The conelets of plates 4 and 5 are destroyed, and the full height of these plates cannot be measured.

TABLE III.—*Measurements of* M^2 *sin. of* A. *cf.* planifrons (*M* 18524)

	No. of plate								
	1	2	3	4	5	6	7	8	Talon
Width . . .	93	100	105	—	105	103	95	71	50
Height . . .	69	74	70	—	—	70	65	54	33
Height-width index .	74	74	67	—	—	68	68	76	66

The number of conelets in the anterior plates is difficult to see because of the cement cover. There is a slight dislocation in the median line of plates 1–3, the labial portions being placed slightly more forward than those on the lingual side. Plate 6 bears five conelets, the two on the labial side are broken off. In plate 7 the number of conelets is likewise five, but in plate 8 there are four conelets only. The talon consists of three cones, and a very small accessory cone on the lingual side.

The length of this M^2 sin. is 242 mm., less than that of the M^2 dext. recorded above. The number of plates is also less (eight instead of nine), but the laminar frequency is the same in both specimens, viz., 3 to $3\frac{1}{2}$. The characteristic median expansions do not show because all the plates are unworn. It will be seen from Table III that the full height of the plates is only two-thirds to three-fourths the basal width (exclusive of cement), which indicates that the M^2 sin. is lower-crowned than the M^2 dext.

The anterior root is divided in the middle, and is preserved for a few centimetres only; the main root is broken off almost entirely, and the junction between the two is on a level with that between the 3rd and 4th plates of the crown.

Another specimen with unworn plates is the hinder end of an M^3 dext. (M 18527). It is broken off anteriorly through the 7th plate from behind, and is much corroded. The enamel is lost along the lingual edges of the plates, exposing the dentine cores. A large portion of the labial surface is covered with plaster. The enamel of the conelets of the plates is broken. Of the roots nothing is preserved. However, allowing for an enamel thickness of 5 mm. it is possible to estimate the widths at base of all the plates, and the height measurements of all but the last two plates and the talon, which are so much damaged that their height cannot be measured. The laminar frequency is 4.

TABLE IV.—*Measurements of M³ dext. of* A. *cf.* planifrons (*M* 18527)

	No. of plate from behind							
	VII	VI	V	IV	III	II	I	Talon
Width . . .	107	95	88	84	75	70	55	. *c.* 25
Height . . .	88	80	75	69	65	—	—	. —
Height-width index .	82	84	85	82	87	—	—	. —

Table IV shows that the unworn plates are less high than wide ; this is also true of the unworn M^2 sin. from Bethlehem.

A portion of a molar consisting of seven fragments (M 18561) contains parts of two unworn, and two worn plates. The width and height of one of the unworn plates (the enamel thickness is 6 mm.) can be determined as 95 mm., and 85 mm., respectively, giving a height-width index of 89, the maximum figure for this index found in the molars described above. The present specimen is broken through the median line of the crown, and clearly shows the V-shaped valleys between the plates, open down to the bottom as is characteristic of archidiskodonts. The laminar frequency of the present fragment is $3\frac{1}{2}$. Its serial position cannot be determined with certainty, but because of the relatively great basal width and low laminar frequency it presumably formed part of a penultimate or a last molar.

A fragment of a molar, probably of the same specimen as the last (M 18525), comprises part of an unworn plate 84 mm. high but of unknown basal width. There are at least five conelets to this plate, the grooves between which remain distinct rootward to over one-half the height of the crown.

Two last lower molars, one right and one left, evidently of the same individual (M 18528 and M 18529) are very much worn down. Their anterior portions are missing ; the left M_3 still comprises seven plates, the right, five only . The anterior plates have their dentine surfaces coalesced as the valleys between them are partially or entirely worn out. The laminar frequency of the occlusal surface is $3\frac{1}{2}$. The enamel is very thick : 5–6 mm. The plate figures of the last four plates are irregularly expanded in the centre ; their lingual portions are placed more forward than the labial, and the enamel bands make contact in the median line of the crown. The greatest width of the crown (at the 5th plate from behind) is *c.* 100 mm., exclusive of cement which is well developed all round the crown. At the 2nd plate from behind the width is 85 mm., and at the talonid, 40 mm. There are accessory enamel cusps labially of the talonid and of the last plate as well as at the lingual entrances to the valleys. Height measurements cannot be given as even the talonids are worn. The main posterior root supports at least six plates and is of great length, the depth of the root below the talonid is 15 cm. at least.

There remain a number of molars, most of them very much worn down, that are either too incomplete or too much damaged for anything of value to be deduced from them. It is evident, however, that they belong to the same primitive archidiskodont elephant as the better-preserved specimens above described ; their enamel is very thick, the laminar frequency is low, the valleys are V-shaped, and the roots are very long. Two much worn molars, evidently of the lower jaw as their

occlusal surfaces are concave from before backward (M 18557, M 18560) display these characters very clearly. The laminar frequency is approximately 4 ; the long roots are distinctly recurved backward. M 18557 seems to have had seven plates only, and presumably represents M_1 sin. The roots indicate that the length of the crown probably did not exceed 165 mm. Width measurements cannot be given. The median expansions of the enamel figures show well in a posterior fragment of another lower molar (M 18554) the root of which is 13 cm. long as preserved. A much worn crown fragment without the roots (M 18538) holds four plates in 10 cm. of length ; the same laminar frequency obtains in a fragment of an upper molar (M 18526) that is interesting because it has had small stones pressed down on the plates with such force that these have been partially broken, and the crown surfaces deflected from their normal position. The following specimens are too fragmentary for their position to be determined : nos. M 18530, M 18531, M 18539, M 18540, M 18541, M 18543, M 18544, M 18551, M 18559.

As mentioned above the most complete and first described specimen of the Bethlehem elephant, viz., the mandible obtained during the 1940 season (M 18582) is indistinguishable from *Archidiskodon planifrons* from the Upper Siwaliks of India. However, in the isolated and (partially or entirely) unworn molars we observe a character in which it appears to differ from the Siwalik *A. planifrons*.

All the relevant data on the molars of the Upper Siwalik *A. planifrons* described and figured by Falconer and by Osborn are contained in two tables by Osborn (1942 : 949, 954). Upper Siwalik specimens of *A. planifrons* collected by Eug. Dubois in the Punjab, and now in the Leiden Museum, including a fine skull closely resembling the British Museum specimen (Falconer & Cautley, 1845, pls. 9, 10), have been described by the author (Hooijer, 1955 : 96–100). The material of *A. planifrons* obtained by the Yale North India Expedition of 1932 (Hooijer, 1955 : 100–102 ; 1956) includes the geologically oldest specimen yet obtained, viz., a portion of M^3 collected near the base of the Tatrot zone first recorded by Lewis (1937 : 198), basal Upper Siwaliks and basal Pleistocene. This specimen (Hooijer, 1956) cannot be distinguished from other M^3 of *A. planifrons* (the bulk of the material is presumably from the Pinjor zone overlying the Tatrot zone), and the plates are higher than wide (height-width indices 110–124). The M^3 *in situ* in the British Museum skull of *A. planifrons* has a height-width index of 115. An M^3 from the Punjab in the Leiden Museum (Hooijer, 1955 : 102, 103) has five unworn plates very nearly as high as wide, the height-width indices varying from 97 to 105.

As can be seen from the tables by Osborn (1942 : 949, 954) the height of the molars of *A. planifrons* as given by Falconer and by Osborn is either greater or much less than the width of the same specimens. Fortunately, most of the specimens have been figured, and from the figures it is evident that where the height exceeds the width the crown has unworn plates, e.g., M^3 : Falconer & Cautley, 1845, pl. 10 (width 89 mm., height 102 mm., index 115) ; M^1 : Falconer & Cautley, 1845, pl. 6, fig. 5 (width 69 mm., height 77 mm., index 112) ; M_3 : Falconer & Cautley, 1845, pl. 12, fig. 13 (width 91 mm., height 114 mm., index 125) ; pl. 12, fig. 12 (width 89 mm., height 102 mm., index 115), Osborn, 1942, fig. 842 (width 101 mm., height 124 mm., index 123) ; fig. 835 (width 109 mm., height 114 mm., index 105). On the other hand, in those molars where the height is less than the width, the height has been

taken at a worn plate, e.g., M^3 : Falconer & Cautley, 1846, pl. 14, fig. 8 (width 89 mm., height 63 mm.), Osborn, 1942, fig. 834 (width 100 mm., height *c.* 88 mm.) ; M^1 : Osborn, 1942, fig. 833 (width 94 mm., height *c.* 66 mm.) ; fig. 832 (width 80 mm., height 65 mm.) ; fig. 831 (width 90 mm., height 67 mm.) ; M_3 : Falconer & Cautley, 1845, pl. 11, fig. 5 (width 105 mm., height 89 mm.), Falconer & Cautley, 1846, pl. 18A, fig. 1 (width 104 mm., height 81 mm.) ; pl. 14, fig. 9 (width 89 mm., height 77 mm.), Osborn, 1942, fig. 855 (width 80 mm., height 53 mm.) ; fig. 839 (width 78 mm., height 45 mm.) ; M_1 : Osborn, 1942, fig. 838 (width 80 mm., height 45 mm.).

The examples given above will suffice to show that the unworn molar crowns of *A. planifrons* from the Upper Siwaliks are either about as high as wide, or higher than wide. In those specimens where the height is less than the width (see above) it is clear from the figures that the height recorded is not the height of the unworn plate, and height-width indices based on these figures are meaningless. They are only indicative of the degree of wear shown by the molars in question, and should be excluded from comparison.

Among the *Archidiskodon* molars from Bethlehem, only the third molars in the mandible M 18582 have a height-width index of just over 100 ; in the remaining specimens the plates are neither fully nor even nearly as high as wide, the highest height-width index found being 89, the lowest (talons excluded) being 67.

It is therefore evident that the Bethlehem *Archidiskodon* does not belong to the species *A. planifrons* as known from the Upper Siwaliks (Tatrot and Pinjor zones) of India. The mandible is within the variation limits of the Siwalik specimens, but the unworn plates of the upper molars (two M^2 and one M^3) show that the Bethlehem *Archidiskodon* is more primitive than *A. planifrons* in the height of the unworn crown being less than the basal width.

Certain primitive archidiskodont molars from the Vaal river gravels in the Transvaal, South Africa, have been described by Osborn (1934, 1942 : 983–988) as *A. subplanifrons*, and *A. proplanifrons*, respectively. Although the Vaal river specimens are claimed by Osborn to be much more primitive than the most primitive molars thus far discovered in the Siwaliks (*A. planifrons*) the point is somewhat difficult to make as none of the South African molars is unworn. The holotype of *A. subplanifrons*, an M_3 dext. (Osborn, 1934, fig. 1 ; 1942 : 987, fig. 874) is worn to and including the hind talonid, and is broken off in front through the 5th plate from behind. The laminar frequency is 4, the enamel thickness, 4 mm. The valleys are V-shaped in longitudinal section, and the enamel figures of the 3rd and 4th plates from behind have median anterior and posterior expansions. In all these characters the specimen resembles the Siwalik *A. planifrons*, and as neither the plate formula nor the exact height of the crown can be determined it would seem unjustified to create a new species for the inclusion of this specimen. The estimated height of the plates is given by Osborn as 53–63 mm.

The holotype of *A. proplanifrons* Osborn (1934 : 10, fig. 2 ; 1942 : 986, fig. 873) is an M^3 dext. with all the plates and the hind talon worn ; it is broken off in front of the 5th plate from behind. The laminar frequency is 3, the thickness of the enamel is 5 mm. Again, there is no way of telling the full number of plates or the height of the unworn crown ; Osborn gives the height of the last plate as 55 mm.; the basal width of the same plate (measured from the figure) is 66 mm. These

measurements are intermediate between those of the last plates in the two second upper molars from Bethlehem recorded above (height *c.* 58 mm., and 54 mm., respectively, and width 55 mm. and 71 mm. respectively), and the resulting height-width index is also intermediate : 83 in *A. proplanifrons*, and *c.* 105, and 76, in the two Bethlehem specimens. However, in the Bethlehem molars the height increases to 84 mm., and 74 mm., respectively, in the more anteriorly placed plates, and Osborn's reconstruction of the type of *A. proplanifrons*, in which all the plates are shown of the same height as the last, is extremely improbable. The last plate is always lower than the others. Osborn further compares the M^3 of *A. proplanifrons* with an M_3 of *A. planifrons* (Amer. Mus. 19965 ; Osborn, 1934, fig. 4 ; 1942, figs. 840, 876) all the plates of which are worn but boldly reconstructed in longitudinal section to a height of about 55 mm. This reconstruction, again, is very improbable, for in the unworn M_3 of *A. planifrons* the crown height is seen to rise to 124 mm. (Amer. Mus. 19951 ; Osborn, 1942, figs. 842, 845, and 855). Osborn (1934 : 9; 1942 : 986) says that the worn M_3 of *A. planifrons* is " the most primitive stage found in the large series of the *Archidiskodon planifrons* molars collected by Barnum Brown in the Upper Pliocene Pinjor horizon of the Siwaliks, India ", but it has a laminar frequency of $4\frac{1}{2}$, whereas the partially unworn M_3, thrice figured by Osborn, has a laminar frequency of $3\frac{1}{2}$–$4\frac{1}{2}$, and another (Amer. Mus. 19952 ; Osborn, 1942, fig. 835) is only $3\frac{1}{2}$–4, which brings *A. planifrons* within the range of laminar frequencies of the South African and Bethlehem types (3–4).

As stated by Dietrich (1942 : 79) and by Cooke (1947 : 455) *A. subplanifrons* and *A. proplanifrons* are conspecific. In my opinion there is no proof at present that they can be specifically distinguished from the Upper Siwalik *A. planifrons* proper, a point that cannot be settled until unworn, entire molars have been found in the same deposits from which the types of *A. subplanifrons* and *A. proplanifrons* were obtained. In revising the South African " species " of *Archidiskodon*, Cooke (1947 : 507) placed *A. subplanifrons* (including *A. proplanifrons*) in group I : " Archidiskodonts (with broad crowns and thick enamel). A : Low Crowned (less than 75 mm.) ", thereby accepting Osborn's low estimates of the crown heights. It seems to me that such a group for the South African types is invalid prior to the discovery of molars with unworn full plates.

Archidiskodon exoptatus Dietrich (1942 : 72) from the Lower Pleistocene of the Southern Serengeti in Tanganyika, East Africa, is very close to the Upper Siwalik *A. planifrons* ; the unworn full plates of the molars are higher than wide. The molars from Kanam and Laetolil, East Africa, described by MacInnes (1942 : 86) as *Archidiskodon planifrons nyanzae*, are all worn ; their laminar frequency is about $3\frac{1}{2}$. None of the molars described by Dietrich (1942) as *A. exoptatus* has a laminar frequency of less than 4.

The North African *Elephas africanavus* Arambourg (1952), found in the Villafranchian (Lower Pleistocene) of Ichkeul, Tunisia, has molar crowns that are either very slightly lower, or higher than wide (height-width index of type M_3, 97 ; of M^1, 110), which is within the limits of the Upper Siwalik *A. planifrons* (97–125, see above). The laminar frequency is $3\frac{1}{2}$ to $4\frac{1}{2}$, the enamel thickness, 4–5 mm. These specimens also appear to be indistinguishable from those of *A. planifrons*.

Archidiskodon planifrons has also been recorded from Villafranchian sites in Europe

(Osborn, 1942 : 961–969 ; Hooijer, 1953) ; the most primitive specimens have laminar frequencies of $3\frac{1}{2}$–4, and their crowns are not higher than wide. It should, however, be realized that these specimens might equally well represent primitive variants of *Archidiskodon meridionalis* (Nesti) ; the molars of these two species grade imperceptibly into one another, without a break to indicate a convenient boundary line between low-crowned *A. planifrons* and higher-crowned *A. meridionalis*.

At the end of this brief survey of primitive Eurasian and African archidiskodonts, let us reconsider the *Archidiskodon* from Bethlehem. It is apparently identical with *A. planifrons* in mandibular characters, but has upper molars that are lower than wide in the unworn state. There are no counterparts of such molars among the known material of the Upper Siwalik *A. planifrons* ; even the geologically oldest specimen, viz., the M^3 from the base of the Tatrot zone (Hooijer, 1956), has unworn plates higher than wide. The East and North African archidiskodonts mentioned above agree with *A. planifrons* in relative crown height, and so do the most primitive archidiskodonts from the Villafranchian of Europe. The crucial question is whether the South African *A. "subplanifrons"* really has lower molar crowns than the Upper Siwalik species ; this is still unknown. The Bethlehem elephant appears to represent a somewhat less advanced evolutionary stage than *A. planifrons* proper, and should perhaps be sub-specifically distinguished. As long as the *"subplanifrons"* problem has not been solved it would seem best to place the Bethlehem elephant on record as *Archidiskodon* cf. *planifrons*.

A large portion of an elephant's tusk, length almost 170 cm. (M 18584), diameter 13 cm. proximally, is so much distorted that the amount of curvature is uncertain. The tusk, however, appears to have been nearly straight as far as preserved. There are also a number of vertebrae and limb bones of the Bethlehem elephant, but except for an atlas they are in a very bad state of preservation. The measurements of the atlas are given in Table V.

TABLE V.—*Measurements, in centimetres, of Atlas of* Archidiskodon *cf.* planifrons *M* 18579)

Total height	26
Facies articularis cranialis, vertical	15
transverse	*c.* 9
Antero-posterior diam. of corpus	9·5
Height of foramen vertebrale	13·5
Least width of *idem*	*c.* 6
Foramen transversarium, diameter	3
Foramen for first cranial nerve, diameter	1·5

The height of the atlas of the *A. planifrons* skeleton from Chagny-Bellecroix is 27 cm. (Mayet & Roman, 1923 : 82).

The following approximate measurements have been taken from a poorly preserved radius: length *c.* 80 cm., greatest proximal width *c.* 11 cm., and greatest distal width *c.* 16 cm.

The measurements of a left femur (M 18583) are, length from head to media

condyle *c.* 112 cm., greatest proximal diameter over head and great trochanter *c.* 33 cm., least width of shaft *c.* 14 cm, greatest distal width *c.* 24 cm.

In the skeleton of *A. planifrons* from Chagny-Bellecroix (Mayet & Roman, 1923 84) the femur measures 133 cm. from head to medial condyle.

In a portion of the pelvis from Bethlehem (M 18585) the diameter of the acetabulum is 21 cm.

A right and a left patella, evidently of the same individual (M 18535 and M 18588), agree in the following dimensions : Height 17·5 cm., width, 13 cm., greatest antero-posterior diameter, 9 cm.

The reference of the tusk and post-cranial material to *A.* cf. *planifrons* is provisional but it is probable that these specimens belong to the same species as the mandible and the molars described above because there is no evidence of the presence of more than one species of elephant in the Bethlehem fauna.

PERISSODACTYLA

Equidae

Hipparion sp.

(Pl. 35, figs. 3–6)

An isolated right lower last molar (M 18518, Pl. 35, figs. 3–4) gives evidence of the presence of *Hipparion* in the Bethlehem fauna. The tooth is in the germ stage and lacks the cement coating ; the height of the crown unfortunately cannot be determined. However, several slightly worn M_3 of *Hipparion gracile* (Kaup) from the Pontian of Pikermi in the British Museum (Natural History) agree with the Bethlehem M_3 in every visible detail of their structure. The sharp vertical groove between metaconid and metastylid is a character common to *Hipparion* and the zebras, but *Equus stenonis*, the smallest zebrine horse of the Villafranchian, has an M_3 larger than the Bethlehem tooth (see Major, 1877–80, pl.7, figs. 21, 30, 31). The Bethlehem M_3 has a length of 25 mm. and a greatest width of 9·5 mm., exclusive of cement. A Pikermi specimen measures 25·5 mm. antero-posteriorly near the top, and 26·5 mm. near the base of the crown (also exclusive of cement), and the greatest transverse diameter of the crown is 11·5 mm., some cement included.

In *Hipparion antelopinum* (Falconer & Cautley) M_3 measures 28 by 12·5 mm.; in *H. theobaldi* (Lydekker) M_3 measures 30 by 13 mm. (Colbert, 1935 : 148). These are Middle Siwalik species, but an isolated M_3 dext. of *Hipparion* from the Tatrot zone, basal Upper Siwaliks, exhibited in the British Museum (Natural History) is very similar : length 29 mm., and width, 11·5 mm., inclusive of cement. *Hipparion* also occurs in the Pinjor zone of the Upper Siwaliks (Pilgrim, 1938 : 447, 449 ; 1944 : 32) where it is associated with *Equus* ; the latter genus is absent from the underlying but likewise Villafranchian Tatrot zone (Hooijer & Colbert, 1951).

Hipparion is known to occur in several European Villafranchian faunas, such as those of Roccaneyra near Perrier, France (Stehlin, 1904, 1929 ; Bout & Azzaroli,

1952 : 39), of Villarroya, Spain (Villalta, 1952 : 107), and of Kisláng, Hungary (Kretzoi, 1954 : 251). Of these faunas only that of Villarroya lacks *Equus*, but, as remarked by Viret (1954 : 182) there is no reason to consider Villarroya any older than the Villafranchian faunas with *Equus*. The last lower molar of the Roccaneyra and Kisláng hipparions is unknown ; three specimens of the Villarroya *Hipparion crusafonti* Villalta measure 26·2 to 29·9 mm. in length, and 10·1 to 11·5 mm. in width, cement included (Villalta, 1952 : 119).

Although the crown height of the Bethlehem M_3 cannot be measured exactly it seems improbable that it belongs to the very hypsodont hipparion (*Stylohipparion*) which occurs in the Villafranchian of North and East Africa (Arambourg, 1947, 1949 ; Dietrich, 1942) in association with *Equus*.

There is a second specimen in the Bethlehem collection referable to *Hipparion*, viz., the distal portion of a small metapodial (M 18576, Pl. 35, figs. 5, 6). This specimen seems to represent the lateral metacarpal or metatarsal, either II sin. or IV dext. The total length of the fragment is only 4 cm. The shaft is much compressed transversely : the surface facing the large median metapodial is flat, the abaxial surface convex. The anterior edge is more marked than the posterior, which is rounded. The distal extremity, somewhat curved backward on the line of the shaft, likewise is much flattened transversely, and consists of a single condyle with a fossa on either side. The fossa on the abaxial surface is marked, and surmounted by a weak tubercle. The distal antero-posterior diameter is 17 mm., the distal condyle width only 8 mm. The shaft is 7 mm. transversely, and diminishes in antero-posterior diameters from 15 mm. just above the distal condyle to 11 mm. at a point only 2 cm. higher up, where the bone is broken off.

The present metapodial fragment closely resembles the fourth metatarsal of *Hipparion* sp. from Roccaneyra figured by Stehlin (1929, fig. 2B), a cast of which has been figured as ? *Hipparion crusafonti* by Villalta (1952 : pl. 23). Whether the specimen from Bethlehem belongs to the fore or to the hind foot, and whether it is the outer or inner lateral metapodial cannot be made out. Determination of its exact position must await the discovery of more complete material, but this fragment provides definite proof of the presence of a three-toed horse in the Bethlehem fauna.

Rhinocerotidae

Dicerorhinus etruscus (Falconer)

(Pl. 33, fig. 5)

In the Bethlehem collection there is an almost entire skull (M 18542, Pl. 33, fig. 5) which unfortunately is crushed to a considerable extent. All the parts are firmly cemented with plaster, evidently in the positions in which they were found. A fragment of the palate with P^{3-4} sin. lies upside down in the right lateral nasal notch, a partially exposed tooth (? P^2 sin.) is seen in the right temporal fossa, and a portion of distinct bone, possibly of the mandible, projects upward through the left temporal fossa. The ventral surface of the skull is concealed by a thick mass of cement. The left zygomatic arch is missing, and the right is broken.

The occipital portion of the skull is rather well preserved, but somewhat distorted ; the right maxillary and the zygomatic process of the jugal are displaced outward and upward, and are almost in the plane of the dorsal surface of the skull. The right upper tooth series is more or less in place but comprises only P^3–M^2, the anterior premolar (P^2) and the third molar being lost.

The dorsal surface of the skull shows numerous cracks and fractures, and the shape of the dorsal profile, therefore, cannot be relied upon. The nasals (incomplete on the left side) show a slight rugosity for a horn, and there is no trace of a nasal septum on their ventral surface ; the skull, therefore, is probably that of a female (cf. Thenius, 1955). The rugosity for the second, frontal horn is likewise slight, and hardly raised ; behind it the skull surface is slightly concave antero-posteriorly, and gently rises into the nuchal crest, which overhangs the occiput. The infra-orbital foramen is just behind the nasal notch, which ends posteriorly on a level with the anterior border of P^4. The anterior border of the orbit is above the anterior portion of M^2. The post-tympanic process has united with the post-glenoid process below the sub-aural channel.

In all these structural characters the skull closely resembles those of *Dicerorhinus etruscus* figured by Falconer (1868, pl. 26), Schroeder (1903, pl. 1, figs. 1, 1*a*), and Schaub (1944, fig. 1), except for the absence of the nasal septum, which apparently is confined to males (Thenius, 1955 : 11–14). The greatest length of the Bethlehem skull, from nuchal crest to tip of nasals, is about 68 cm. the greatest length of the Florence Museum skull figured by Falconer (1868) as well as by Schroeder (1903, pl. 1, figs. 2, 2*a*) is slightly less, 64 cm. The length from the anterior border of the right orbit to tip of nasals is about 34 cm. in the Bethlehem skull, against about 32 cm. in the Florence Museum skull. The height of the nuchal crest, right side, from lower surface of condyle, is 15·5 cm. against 16·5 cm. in the Florence Museum skull. The greatest width of the frontals (right half only) is 11·5 cm. in both skulls (Falconer, 1868 : 358). These figures tend to show that the Bethlehem skull agrees well with that of *D. etruscus* in size ; further measurements cannot be given because of the crushing of the specimen.

The dentition of the present specimen is badly preserved ; all the internal borders of the crowns are incomplete, and the external surfaces broken and distorted. It is, therefore, impossible to measure the crowns exactly. However, there is little or no crown cement, the anterior cingulum is prominent and slightly inclined upward, there is a horizontal lingual cingulum (P^3 sin.), and a high and wide entrance to the medisinus ; all characters pointing to *D. etruscus* (Falconer, 1868 : 354–368 ; Dawkins, 1868 ; Wüst, 1901 : 273 ; Schroeder, 1903 ; Bernsen, 1927 ; Vialli, 1956). In all the premolars and molars present the crochet is rather large, and united to the crista so as to cut off a medifossette ; this is an individual peculiarity that is apparently rare in *D. etruscus*, although in many of the specimens figured by the above cited authors there are traces of cristae beside the large crochets (Falconer 1868, pl. 29 ; Dawkins, 1868, pl. 8 ; Wüst, 1901, pl. 4, figs. 2, 4, 7, 8 ; Schroeder, 1903, pl. 4 ; Bernsen, 1927, pls. 1, 2 ; Vialli, 1956, pl. 1, fig. 5). Small cristae are also seen in the complete upper dentition of *D. etruscus* figured by Tuccimei (1891, pl. 11).

In the collection there is also a fragment of the maxillary with the right P^3–M^2

(M 18563, M 18570). The two premolars have broken off at their bases, but the anterior portion of the ectoloph of P^4 dext. is preserved (M 18577). Of M^1 a small posterior portion, with the laterally compressed post-sinus, only remains. M^2 is the best preserved tooth, lacking, however, the hinder portion. The anterior cingulum is only slightly inclined upward toward the external side, the crown is low, and does not show any cement, there is an inner cingulum forming a knob at the wide entrance to the medisinus, and the crochet is large. There is also a very weak crista, which would, however, never unite with the crochet. The antero-transverse diameter of the crown base of M^2 is 59 mm.

Nos. M 18563, M 18572, and M 18577 comprise a number of fragments, some of which may well have formed part of the dentition just mentioned.

An isolated M^1 or M^2 sin. (M 18562), partially restored with plaster, has all the characters distinctive of *D. etruscus* enumerated above. There is no crista, but a small antecrochet. The lingual cingulum is stronger than that in M 18563.

A left (?) M^1 (M 18564), found in 1935, is very incomplete but shows the characteristic inner cingulum.

A broken and distorted portion of the left ramus of the mandible with part of M_3 *in situ* (M 18558) is of the 1940 season. Portions of lower molars are further contained in specimens M 18574 and M 18514.

Dicerorhinus etruscus (Falconer), to which the Bethlehem rhinoceros may be confidently referred, is characteristically a Villafranchian type widely spread in Europe (see, e.g., Viret, 1954, table opposite p. 184).

ARTIODACTYLA

Suidae

Sus cf. *strozzii* Meneghini

(Pl. 33, fig. 1 ; Pl. 34, fig. 8)

In the Bethlehem collection there are two specimens that belong to a suid very close to or identical with *Sus strozzii* Meneghini, a species thus far known from the Villafranchian of Italy, France (Sénèze), and the Netherlands (Tegelen) only. The first of these (M 18515) is a fragment of the right mandibular ramus with the second premolar (P_2) unerupted. The crown measures 12·8 mm. antero-posteriorly. In a mandible from Tegelen described by Schreuder (1945 : 188) P_2 measures 13·0 by 7·0 mm. The Bethlehem specimen also displays part of the alveolus of the canine ; the internal upper angle of the alveolus is approximately a right angle, which shows it to have lodged a canine of the *verrucosus* type (Azzaroli, 1954 : 44, fig. 2). The width of the upper surface of the alveolus is over 10 mm. as far as preserved, and this surface is perfectly straight and the canine thus agrees with those of male individuals of *Sus strozzii* (Azzaroli, 1954 : 63, fig. 7). The second specimen (M 18520) is a left upper incisor, probably I^2 sin., rather worn. The length and width of the crown are 14 mm. and 6·5 mm, respectively. A left second upper incisor is *in situ* in a skull of *Sus strozzii* from the Val d'Arno figured by Azzaroli (1954 : pl. 10, fig. 4*a*),

but its measurements have not been given. The upper incisors of the Tegelen *Sus strozzii* are unknown as yet, and in the sub-adult Sénèze specimen (Schaub, 1944 : 276, fig. 3 ; Azzaroli, 1954 : pl. 15, fig. 4*b*) they are missing.

The existence of *Sus* cf. *strozzii*, at any rate of a large suid with a *verrucosus*-like lower canine, at Bethlehem is interesting in view of the fact that *Sus strozzii* of the Val d'Arno, Sénèze, and Tegelen is generally accepted to be an invading form from Asia. There is no fossil species of *Sus* known from Asia that meets all the conditions ancestral to *Sus strozzii*, however, and both Schaub (1944 : 277) and Azzaroli (1954) derive *Sus strozzii* from *Sus minor* Depéret of the Pliocene of Roussillon.

Giraffidae

Giraffa cf. *camelopardalis* (L.)

(Pl. 34, figs. 5, 6)

A small fragment of a molar, the distal portion of a metapodial and a crushed distal condyle of another metapodial give evidence of the presence of a giraffe in the Bethlehem fauna.

The molar fragment (M 18517, Pl. 34, figs. 5, 6) is part of the external surface of a left upper molar, probably M^3. It comprises the portion just behind the prominent median rib of the antero-external cusp (paracone) backward to and including the weak median rib of the postero-external cusp (metacone). The preserved portion of the paracone slopes inward, and abuts against the metacone with a small but distinct, hook-shaped, outward turn. Between the paracone and the anterior style of the metacone there is an outer valley, 2 mm. wide and about 4 mm. deep, that extends rootward to 7 mm. from the crown base. The anterior style of the metacone is very prominent, and marked off behind by a sharp fold that likewise extends rootward to 7 mm. from the border of the enamel. It is worn down to a height of 13 mm. from the crown base ; the highest points of the paracone in front, and of the metacone behind it are 16 mm. high from the crown base, as worn. The median external rib of the metacone is weakly developed, and is more inclined inward than the paracone. The enamel is rugose. Internally, the molar fragment is broken off vertically just along the high and narrow pulp cavities of the external cusps.

I have compared the present fossil fragment with a number of dentitions of the Recent giraffe, and found the closest resemblance with the external portion of the left M^3. Doubtless there is much individual variation in the development of the anterior style of the metacone, which is very strongly marked in some, and only slight in others. The closest approach to the condition seen in the fossil is in two specimens (Leiden Museum, 7085 and 4216), in which the anterior metacone style is distinctly marked off behind by a groove, and as prominent laterally as that in the fossil, although not quite so thick (3–4 instead of 5–6 mm.). The valley just anterior to it is a little wider in the Recent specimens than in the fossil, and the basal cingulum in the Recent specimens is a trifle less high (5–6 mm. instead of 7 mm.). However, had more Recent dentitions been available it is quite probable that the condition observed in the fossil would be seen to fall within the limits of individual

variation in the Recent giraffe. It is important to note that the fossil specimen does not appear to be larger than the Recent ; the distance between the apices of the external surfaces of para- and metacone is about 14 mm. in the fossil as well as in the Recent molars.

The next specimen referable to a giraffe is the distal portion of a metatarsal (M 18508, found in 1934. It has largely been restored with plaster. The dorsal surface has a shallow vascular groove, as in the metatarsals of the Recent giraffe, but the foramen perforating the shaft distally does not show. The volar surface is restored with plaster for a height of 3–4 cm. above the condyles, but more proximally shows a weak median ridge, emerging about 6 cm. above the condyles, and flattening out at about 11 cm. above the condyles, at which level the bone is broken off. At this point the volar surface is still slightly convex transversely. In Recent metatarsals of *Giraffa camelopardalis* there is exactly the same condition, the posterior median longitudinal groove that extends along most of the length of the shaft fades away some 12–15 cm. above the distal condyles, to be replaced distally by a weak median ridge. The greatest distal width of the fossil metatarsal is about 85 mm. (85–90 mm. in three Recent metatarsals), and the greatest dorso-volar diameter of the condyles in the fossil specimen is 54 mm. (54–55 mm. in the Recent). The distal condyle width is greater in the fossil than in the Recent metatarsals (about 84 mm. as opposed to 78–80 mm.), but the condyles are slightly less closely approximated in the fossil, which is apparently due to a slight fault in the reconstruction. The condyles are shaped exactly as those in the Recent specimens used for comparison.

The last specimen (M 18507) is an isolated distal condyle of a metapodial, broken, and with the abaxial part displaced upward relative to the axial portion. Exact measurements cannot be given, but the specimen seems to be slightly larger than the corresponding part of the metatarsal, and, therefore, may have formed part of a metacarpal instead.

The remains described above differ slightly, if at all, from the Recent giraffe, and may be identified as *Giraffa* cf. *camelopardalis* (L.). This species has never been recorded in the fossil state from Europe, but remains apparently indistinguishable from the living species of *Giraffa* have been recorded from Villafranchian deposits in East and South Africa (Dietrich, 1942 : 112 ; Arambourg, 1947 : 375 ; Cooke & Wells, 1947). The presence of this form sets a decidedly African stamp upon the Bethlehem fauna.

Bovidae

Leptobos sp. nov.?

(Pl. 33, fig. 4)

A right horn core (M 18522) broken off approximately at the base, and without the tip, must be referred to *Leptobos*. The core is slightly compressed vertically at the base, and is curved backward and outward in a gentle curve ; the distal half is curved upward. In the basal portion there are distinct longitudinal grooves along the posterior upper and the anterior lower surfaces ; these grooves indicate a slight anti-clockwise torsion. They flatten out toward the middle of the length

except for one along the lower surface anteriorly that continues to about 10 cm. from the broken distal end. Another, along the lower surface posteriorly, originates only in the middle of the length, and flattens out some 15 cm. from the broken end. Apart from these grooves the distal portion is smooth.

The length of the horn core from base to broken end is 65 cm. along the outer curve ; it describes about one-fourth of a circle. The basal diameters are about 94 mm. horizontally, and 86 mm. vertically ; these diameters have diminished to 76 mm., both ways, at the middle of the length. At the broken distal end the core still measures 48 mm. in diameter, and remains perfectly round in cross section.

The present specimen, although incomplete, resembles the horn core of *Leptobos stenometopon* (Rütimeyer, 1867, pl. 1, figs. 3, 4 ; 1878, pl. 7, fig. 3 ; Merla, 1949, pl. 8, fig. 1 *a, c*) except in size : the horn core of the latter species is only two-thirds as long as the incomplete Bethlehem specimen (Table VI). The Bethlehem horn core differs from the other European Villafranchian species of *Leptobos*, viz., *L. etruscus* (Falconer) and *L. vallisarni* Merla, in having the convexity backward and inward instead of outward (Merla, 1949 : 71, fig. 2). The horn cores of the two last-mentioned species, moreover, are shorter than the Bethlehem specimen. In *Leptobos falconeri* Rütimeyer of the Pinjor zone of the Upper Siwaliks the complete horn core is unknown ; the American Museum specimen restored by Pilgrim (1937 : 816, 817), although it has the convexity backward and inward just as in the Bethlehem specimen, is less curved than either the Bethlehem core or that of *L. stenometopon*.

TABLE VI.—*Measurements of Horn Core of* Leptobos *species*

	Bethlehem	*stenometopon*	*etruscus*	*vallisarni*	*falconeri*
Length along outer curve	650+	420	500	330	*c.* 590
Basal diameters	94×86	72×58	79×73	88×77	85×77
Idem, middle of length	76×76	56×46	50×50	75×62	—
Idem, 7 cm. from tip	(48)	35×32	32×34	45×40	—

The Bethlehem core undoubtedly represents a species of *Leptobos*, but does not seem to be identical with any of the European species[1] (Merla, 1949) or with the Upper Siwalik *L. falconeri* (Table VI). There are further specimens of *Leptobos* in the Bethlehem collection, viz., a horn core fragment about 71 by 66 mm. in diameters (M 18556), a broken distal condyle of a metapodial (M 18552), a proximal sesamoid (M 18567), and, finally, two fragments of what appear to be upper premolars (M 18519) but these specimens are of no use for comparative purposes. To indicate the possibility that the Bethlehem *Leptobos* eventually may prove to be a new species it is recorded provisionally as *Leptobos* sp. nov.?

Gazellospira torticornis (Aymard)

(Pl. 33, figs. 2, 3)

The collection contains four mandibular rami, six isolated molars and molar fragments, as well as the distal epiphysis of a right radius and a second phalanx that belong to an antelope. The upper dentition is badly represented : two very

[1] *Leptobos* is the only bovine in the Villafranchian of Europe (Pilgrim, 1938 : 451, 466 ; 1944 : 29).

incomplete upper molars (M 18548, and one fragment M 18519) do not show any diagnostic characters. The lower dentition, however, is very characteristic.

A left horizontal ramus of the mandible (M 18536) has the full permanent dentition P_2–M_3 (Pl. 33, fig. 3). The ramus is fractured below and in front of the premolars, and the fractures are filled with matrix, leaving a diastema between P_4 and M_1, while P_2 is displaced backward and outward. The teeth are undamaged except for P_2, which lacks part of the anterior border of the crown. P_2 is simply built ; its external surface is about as wide as high, and shows a single cusp and a very weak posterior fold. The internal surface is not exposed. P_3 has an inner cusp, two anterior and two posterior wings. The anterior valley is open internally, but the inner cusp is united to the posterior wing, the posterior outer fold is stronger, and the external surface is higher than wide. P_4 has a closed internal wall ; there is a small but marked anterior internal fold, while the posterior lobe is marked off by a deep external fold. The molars are characterized by weak internal ribs, strong anterior folds both internally and on the external side, and the apparent absence of basal pillars. The crowns are hypsodont and rather narrow ; M_{1-2} possess a postero-internal fold, M_3 has a laterally compressed third lobe.

A right ramus of the mandible (M 18534) lacks the two anterior premolars, and the third lobe of M_3 ; the ramus is broken and also distorted at M_1. In the closed internal wall and marked external fold P_4 resembles that of the preceding ramus closely. The molars likewise agree with those of the foregoing specimen in the presence of strong anterior folds, internally as well as externally, and in their weakly ribbed internal surfaces. Basal pillars are not exposed either.

M 18533 is a younger specimen than the foregoing rami ; the milk molars DM_{2-4} are still in place, and M_3 just appears above the alveolar margin. DM_2 and DM_3 resemble their successors in the permanent dentition in crown structure but are narrower and more elongated ; DM_4 is three-lobed ; the cingulum forms a knob at the base of the groove separating the second and third lobe externally. As in the molars, there is a postero-internal fold. The molars show the anterior folds very distinctly ; the internal ribs are more marked apically than those in the more worn molars of M 18536 and M 18534, but become less distinct toward the base. The antero-posterior diameter of the crown diminishes rootward so that the length of an unworn or slightly worn molar is greater than that of a much worn specimen. The hypsodont character of the molars is shown by a fragment of the left mandibular ramus (M 18532) with M_3 unerupted ; the height of the slightly worn M_2 in this specimen is not less than 30 mm. by a transverse diameter of the crown of only 8·5 mm.; the antero-posterior diameter of the crown is 19·5 mm. apically.

An isolated right M_1 (M 18546), moderately worn, and a right M_3 (M 18545), the second and third lobes of which are incomplete, possess the characteristic anterior folds and weak ribs of the preceding specimens. In these specimens the base is exposed, and there are cingular knobs at the external grooves between the lobes basally. The transverse diameters of the crowns slightly increase rootward, while the antero-posterior diameters decrease from the apex toward the base of the crown. Finally, a much worn M_3 sin. (M 18537) shows that the third lobe is shorter antero-posteriorly at base than the second lobe, and much compressed laterally. There is no basal knob in the groove between the second and third lobes, but there is a regular basal

pillar between the first and second lobes externally. The folds at the anterior end of the crown are very marked on both sides. In M_1 the postero-internal fold is also marked.

TABLE VII.—*Measurements of* Gazellospira torticornis

	M18533	M18534	M18536	M18546 M18532 M18545	Pilgrim & Schaub, 1939
DM_2, ant. post.	7·5	—	—	—	8·2
transv.	3·9	—	—	—	—
DM_3, ant. post.	11·1	—	—	—	10·5
transv.	5·5	—	—	—	—
DM_4, ant. post.	17·8	—	—	—	19
transv.	8·1	—	—	—	—
Length DM_{2-4}	37·5	—	—	—	36
P_2, ant. post.	—	—	*c.*9	—	9·5–10
transv.	—	—	—	—	—
P_3, ant. post.	—	—	10·8	—	14
transv.	—	—	7·0	—	—
P_4, ant. post.	—	13·0	13·0	—	*c.*16
transv.	—	7·7	7·8	—	—
Length P_{2-4}	—	32	—	—	37
M_1, ant. post.	—	16·5	15·9	17·9	—
transv.	9·3	9·9	9·1	9·0	—
M_2, ant. post.	20·0	19·0	18·7	19·5	—
transv.	9·0	9·6	9·5	8·5	—
M_3, ant. post.	—	—	22·8	—	—
transv.	—	8·7	7·9	10·2	—
Length M_{1-3}	—	—	58	—	61·5–72
Height of ramus below M_1	24	27	26	—	24
Idem, below P_2	—	23	—	—	21

Although nothing of the skull or of the horn cores is preserved, the lower dentition of the Bethlehem antelope leaves no doubt as to its specific position : it clearly belongs to *Gazellospira torticornis* (Aymard) as described by Pilgrim & Schaub (1939). There is such a close resemblance between the Bethlehem specimens and those from the Villafranchian of Roccaneyra, La Loubière de Pardines, and Sénèze described and figured by Pilgrim & Schaub (1939), not only in structural details but also in size (Table VII), that their conspecificity is rendered certain. The ascending ramus of the Bethlehem mandibles is not preserved, but the anterior end is more complete than in the specimens figured by Pilgrim & Schaub ; the distance between P_2 and the mental foramen is 30 mm. both in M 18534 and in M 18533, and the height of the ramus half way between, 15 mm.

With the aid of Pilgrim & Schaub's monograph it has also been possible to identify a few limb bones in the Bethlehem collection : the distal epiphysis of a right radius (M 18510) agrees perfectly with that of *Gazellospira* from Roccaneyra (Pilgrim & Schaub, 1939, pl. 3, fig. 20), and differs from that of deer in the same points mentioned (p. 15) : the lunar and scaphoid facets are wider, the former almost reaches the ulna, and extends more distally, the latter is less convex antero-posteriorly, etc. The greatest distal width cannot be measured in the Bethlehem specimen, but that of the distal articular surface is 35 mm. as in a Sénèze specimen (p. 19). There is also a

second phalanx (M 18575), damaged proximally, the length of which is 30 mm. and the proximal width, 15 mm., as in a *Gazellospira* phalanx II from Sénèze (Pilgrim & Schaub, 1939 : 20, pl. 3, fig. 6. lower figs.).

Gazellospira torticornis is a characteristically Villafranchian species known from France, Italy, and Spain (Villarroya : Schaub, 1944 : 280). Its occurrence at Bethlehem is of interest as according to Pilgrim & Schaub (1939 : 29) the species may be considered to be an immigrant from Asia.

AGE AND COMPOSITION OF THE BETHLEHEM FAUNA

The faunal list of the mammals from Bethlehem resulting from the present study is as follows :

Nyctereutes megamastoides (Pomel).
Homotherium (?) sp.
Archidiskodon cf. *planifrons* (Falconer & Cautley).
Hipparion sp.
Dicerorhinus etruscus (Falconer).
Sus cf. *strozzii* Meneghini.
Giraffa cf. *camelopardalis* (L.).
Leptobos sp. nov.?
Gazellospira torticornis (Aymard).

This faunal assemblage as a whole leaves no doubt as to the age of the bone-bearing beds of Bethlehem. It is a characteristic Villafranchian fauna, and there is general agreement nowadays among palaeomammalogists that the Villafranchian should be assigned to the basal Pleistocene. Thus, Miss Bate's preliminary statement of the age of the Bethlehem fauna is borne out by the present study.

When the list given above is compared with Miss Bate's provisional list of 1937 given in the introduction to the present paper certain discrepancies will be observed. I have found no evidence of the presence of *Hippopotamus* in the Bethlehem fauna, and none of *Stegodon* either. It is suggested that Miss Bate's record of the hippopotamus is based on a deceptive fragment of an *Archidiskodon* molar, in which the median looped expansions of the plates, at a certain stage of wear of the crown, may resemble the trefoil pattern of the cusps in a *Hippopotamus* molar. There is such a misleading fragment in the Bethlehem collection (M 18543). Likewise, it would seem evident that Miss Bate's record of *Stegodon* in reality is based on an *Archidiskodon* molar. The Bethlehem *Archidiskodon* cf. *planifrons* is an exceptionally low-crowned form, and such forms may be easily mistaken for stegodonts. On the other hand, I have been able to add one faunal element, viz., *Sus* cf. *strozzii*. This form is poorly represented in the collection, and the two small fragments must have been overlooked in the provisional study of the Bethlehem fauna.

We know nothing as yet of the so-called microfauna, the small mammals such as insectivores, bats and rodents. The condition in which the small carnivore (*Nyctereutes megamastoides*) was found, however, is an indication that the small animals would have been unable to withstand the conditions of the bone-bearing deposit.

On comparing the Bethlehem fauna as we now know it with well-known European

Villafranchian faunas such as those of Perrier, Sénèze, and Saint-Vallier (Schaub, 1944; Viret, 1954) we notice two important differences: the Bethlehem fauna lacks Cervidae, and contains *Giraffa*. In the absence of cervids and the presence of the giraffe the Bethlehem fauna agrees with those from the Villafranchian of East and South Africa (Arambourg, 1947). The Bethlehem fauna, however, differs from the East and South African faunas of the same age in the presence of *Nyctereutes*, *Dicerorhinus*, and *Gazellospira*, which are characteristic of the Villafranchian of Europe.

Therefore, the Bethlehem fauna is predominantly European, or rather Eurasiatic in character, with an African stamp upon it, as, in fact, might have been expected *a priori* from its geographic position.

As such, the Bethlehem fauna provides a faunistic link for the Villafranchian between the continents to the north and that to the south. It is one of those rare Villafranchian faunas such as that of the Tatrot zone of the Upper Siwaliks and that of Villarroya in Spain in which *Hipparion* lingers on and from which *Equus* is absent. Its *Archidiskodon* would appear to be more primitive even than that of the Tatrot (Hooijer, 1956), but the faunal assemblage of Bethlehem is as characteristically Villafranchian as any, and adds materially to our knowledge of the distribution of the sites over the Old World that give evidence of the great mammalian migration that occurred, we believe, at the beginning of the Pleistocene.

The so-called industry of the Bethlehem bone-bearing beds (see Gardner & Bate, 1937) has been re-examined by Dr. J. Desmond Clark who concluded that all the flaking has the characteristics of a natural origin. His report will be published later.

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PLATE 32

Archidiskodon cf. *planifrons* (Falconer & Cautley)

FIG. 1. Mandible, right view. × 2/11. M 18582. Bethlehem.

FIG. 2. Same, top view. × 2/11.